3. Report on the Deaths which occurred in the Zoological Gardens during 1915, together with a List of the Blood-Parasites found during the Year. By H. G. Plimmer, F.R.S., F.Z.S., Professor of Comparative Pathology in the Imperial College of Science and Technology, London, and Pathologist to the Society.

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On January 1st, 1915, there were 733 mammals, 2073 birds, and 371 reptiles in the Zoological Gardens; and during the year 280 mammals, 1167 birds, and 237 reptiles were admitted, making a total for the year of 1013 mammals, 3240 birds, and 608 reptiles.

During 1915, 280 mammals, 706 birds, and 179 reptiles have died: that is, a percentage of 27·6 for mammals, 21·7 for birds, and 29·4 for reptiles.

Out of the total deaths for the year, 1165 in all, 378 occurred in animals which had not been six months in the Gardens: that is, about one-third of the total number. It has been found that after six months' residence in the Gardens the death-rate of the animals falls rapidly; so it is assumed that by this time the new arrivals have got over their journeys, or have died from any diseases they may have brought with them, or have got quite used to their new environment. Of these 378 animals 90 were mammals, 200 were birds, and 88 were reptiles; and if these be deducted from their respective totals, the death-rate percentage will come out as 18·6 for mammals, 15·6 for birds, and 14·9 for reptiles.

The following Tables show in outline the facts which have been ascertained. Table I. summarizes the actual causes of death in the three groups specified. Under Reptiles are included Amphibia.

Table I.—Analysis of the Causes of Death.

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following.
1. *Microbic or Parasitic Diseases.*				1
Tuberculosis	6	60	2	2
Mycosis	10	32	6	3
Pneumonia	48	70	34	4
Septicæmia	5	...	1	5
Abscess	...	1	...	
Pericarditis	...	1	...	
Peritonitis	1	2	...	6
Empyema	5	...	...	
Bronchiectasis	1	...	...	7
Pyelitis	1	...	...	

Table I.—Analysis of the Causes of Death (*continued*).

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following.
1. *Microbic or Parasitic Diseases* (cont.).				
Cystitis	1	...	...	8
Hæmogregarinosis	...	...	1	9
Coccidiosis	2	...	...	
Saccharomycosis	...	...	3	
Toxoplasmosis	...	...	1	10
Syngamus	...	6	...	
2. *Diseases of Respiratory Organs.*				
Atelectasis	1	...	...	
Bronchitis	10	...	...	11
Congestion of lungs	13	130	11	
Broncho-pneumonia	34	...	...	
3. *Diseases of the Heart.*				
Pericarditis	...	1	...	
Degeneration of heart-muscle	...	1	...	
4. *Diseases of the Liver.*				
Hepatitis	...	1	...	
Cirrhosis	1	...	...	
Fatty degeneration	...	4	1	
5. *Diseases of the Alimentary Tract.*				
Gastritis	1	1	2	
Gastric ulceration	4	...	...	
Gastro-enteritis	11	1	6	12
Enteritis	25	150	8	
Intestinal obstruction	2	1	...	
Intussusception	4	...	...	
6. *Diseases of Urinary and Generative Organs.*				
Nephritis	40	81	6	13
Cystitis	1	...	...	
Salpingitis	...	8	1	
Retained placenta	1	...	...	
Atrophy of uterus	1	...	...	14
7. *Various.*				
Carcinoma	2	...	...	15
Sarcoma	3	...	...	16
Adenoma	1	...	...	
Angioma	1	1	...	
Chloroform poisoning	1	...	...	
Osteomalacia	...	1	...	
Injuries discovered *post-mortem*	1	2	...	

Besides those tabulated above,

38 mammals, 113 birds, 4 reptiles, were killed by order or by companions,

1 ,, 6 ,, 51 ,, died from malnutrition or starvation,

4 ,, 31 ,, 41 ,, were too decomposed for examination.

In Table I. an analysis is made of the immediate causes of death, but in nearly every case the animals were found to be suffering from other lesions as well. Table II. summarizes these other diseases from which the animals were suffering; and if this Table be taken in conjunction with Table I., a much more accurate estimate of the amount of disease in the Gardens will be arrived at.

Table II.—Secondary Diseases found in the animals tabulated in Table I.

Diseases.	Mammals.	Birds.	Reptiles.	Reference to Notes following.
Tuberculosis	...	13	1	
Mycosis	...	2	...	
Pneumonia	5	...	1	
Pericarditis	5	...	...	
Peritonitis	2	...	...	
Abscess	...	1	1	
Pyorrhœa	2	...	...	
Hydatids	2	...	...	
Worms	1	2	2	
Malaria	1	8	...	17
Filaria	2	6	1	18
Leucocytozoa	...	3	...	19
Scabies	2	...	...	
Suppuration	2	...	...	
Necrosis	3	...	...	
Amœbic infection	...	...	4	20
Hæmogregarines	...	...	17	21
Bronchitis	8	...	...	
Broncho-pneumonia	8	...	...	
Congestion of lungs	23	157	5	
Œdema of lungs	1	134	9	
Hydrothorax	1	...	...	
Dilated heart	2	7	...	
Atheroma	5	4	...	
Aneurism	2	...	...	22
Pericarditis	...	11	...	
Degeneration of heart-muscle	4	8	...	
Hydropericardium	...	2	...	
Hepatitis	...	6	2	
Fatty degeneration of liver	17	45	12	23
Cirrhosis	5	1	...	
Gastritis	2	...	1	
Gastric ulceration	14	...	...	24
Gastro-enteritis	5	...	1	
Enteritis	41	109	6	
Intussusception	2	...	...	
Atony of intestine	1	...	...	25
Nephritis	43	81	4	
Stone	1	...	...	26
Pregnancy	1	...	...	
Salpingitis	...	1	...	
Sarcoma	1	...	...	27
Ascites	3	4	2	
Hæmorrhage	1	...	...	
Spinal curvature	1	...	...	
Rickets	17	...	...	
Osteomalacia	...	1	...	
Injuries	4	9	...	

Table III. shows, in still further detail, the distribution of the immediate causes of death amongst the various orders of mammals.

TABLE III.—The Distribution of Diseases causing Death amongst the principal Orders of Mammals.

Diseases.	Primates & Insectivora.	Carnivora.	Rodentia.	Ungulata.	Edentata.	Marsupialia.
Tuberculosis	2	...	1	3	...	...
Mycosis	...	...	1	3	...	6
Pneumonia	16	7	17	3	1	4
Empyema	1	3	1	...	...	...
Peritonitis	...	...	1	...	...	...
Septicæmia	2	...	3	...	...	...
Pyelitis	...	1	...	...	...	...
Bronchiectasis	...	...	...	1	...	...
Coccidiosis	...	...	2	...	...	...
Cystitis	...	1	...	...	...	...
Bronchitis	8	...	...	1	...	1
Broncho-pneumonia	15	3	4	8	2	2
Congestion of lungs	5	...	3	3	1	1
Atelectasis	...	...	...	1	...	...
Cirrhosis of liver	...	1	...	...	...	...
Gastritis	1	...	...	...	...	...
Gastric ulceration	3	1	...	...	...	...
Gastro-enteritis	2	8	...	1	...	...
Enteritis	10	2	5	6	...	2
Intussusception	2	2	...	...	...	...
Intestinal obstruction	...	1	1	...	...	...
Nephritis	2	21	8	6	...	3
Cystitis	...	1	...	...	...	...
Atrophy of uterus	...	...	...	1	...	...
Retained placenta	1	...	...	...	...	...
Sarcoma	...	...	1	2	...	...
Carcinoma	...	1	...	1	...	...
Adenoma	1	...	...	...	...	...
Angioma	...	1	...	...	...	...

The following, Table IV., shows the number of Deaths from the numerically important Diseases for the last four years: the total number of animals of each class is placed above, so that a proper comparison can be made.

Table IV.

Mammals.

Year	1912.	1913.	1914.	1915.
Total number of mammals	1391	1272	1261	1013
Tuberculosis	14	31	12	6
Mycosis	12	8	6	10
Pneumonia	45	34	53	48
Bronchitis	12	6	11	10
Broncho-pneumonia	30	25	24	34
Congestion of lungs	14	14	14	13
Gastro-enteritis	11	7	16	11
Enteritis	38	33	33	25
Nephritis	89	90	66	40

Birds.

Total number of birds	3526	3518	3610	3240
Tuberculosis	79	104	113	60
Mycosis	72	75	88	32
Pneumonia	98	89	118	70
Congestion of lungs	108	98	133	130
Enteritis	154	148	169	150
Nephritis	104	135	129	81

Reptiles.

Total number of reptiles	1166	1169	1045	608
Tuberculosis	11	6	4	2
Mycosis	2	1	10	6
Pneumonia	124	138	69	34
Congestion of lungs	22	13	19	11
Enteritis	25	15	17	8

Notes on the foregoing Tables.

1. The total incidence of microbic and parasitic diseases in the Gardens for 1915 is 7·8 per cent. for mammals, 5·3 per cent. for birds, and 7·8 per cent. for reptiles. Practically this percentage is caused by the deaths of animals which had not been six months in the Gardens; if these be excluded, the percentage is under 1 per cent. for mammals and birds, and just over 1 per cent. for reptiles.

2. The deaths from tuberculosis have never been so few since accurate records have been kept as during this year. The percentage of animals dying from tubercle is ·5 for mammals, 1·8 for birds, and ·3 for reptiles. Three ungulates died from tubercle of human type, probably caused by spitting, which is one of the vices of visitors to the Gardens. A Cercopitheque

and a Baboon were both pet animals, but neither of them was allowed out of quarantine, which is the best way of keeping fresh infections out of the Gardens. The birds show a remarkable reduction of deaths from tubercle of nearly 50 per cent.; and, if the overcrowding of many of the bird-houses could be done away with, there does not seem any reason why there should not be a still further improvement. The greater number of the cases have been amongst the Gallinaceous birds, but this year a Flamingo succumbed to tubercle, for the first time since records have been kept. In only 19 of the birds were the lesions generalized, which is a much smaller percentage than usual, and indicates a less severe type of the disease. The 2 cases in the Reptile-houses make the smallest number since records were kept: there seems no reason why it should not be completely driven out. One of these cases was in a Crocodile, in which it was general; this is the first recorded case in this particular animal.

3. All the mould diseases are grouped under Mycosis. 6 of the mammals were Kangaroos and the disease was of the ordinary type; it occurred in a Deer and a Squirrel, for the first time, forming tumours in both—the moulds in each of these two cases were of a species new to the Gardens. There is a very great reduction in the number of cases occurring in birds, of considerably over 50 per cent. A Duck 14 days old was filled with growth of the organism, and, in a Pheasant, mycetomata (mycotic tumours) occurred in the lungs, which is very unusual in birds. Amongst the reptiles a Ceratophrys and an Anaconda died from mycetomata, and a Ceratodus, which had been many years in the Gardens, died from a mould disease of the skin, similar to that from which several of the larger toads and frogs have died.

4. There is a more than relative decrease in the number of cases of pneumonia, especially among the birds and reptiles. In the mammals it seems to be particularly associated with pyorrhœa and rickets. In two of the reptiles it was due to worm eggs and embryos, in the rest it was pneumococcal.

5. The septicæmias were due to dirty wounds in 3 cases, to pneumococci in 2 cases, and to an abscess in the antrum in 1 case.

6. Due to worm-cysts in a Squirrel, and in both of the birds due to injury, from, in the one case a nail, and in the other a thorn.

7. This occurred in a Deer, associated with putrid bronchitis, and was of the sacculated variety. It is the only case I have seen in an animal.

8. This was an acute hæmorrhagic cystitis in a Wolf, due to infection with *Bacillus coli*.

9. In a Cobra in which over 60 per cent. of the erythrocytes were infected.

10. Due to a rare parasite whose position is still uncertain, and found here in a reptile for the first time.

11. There has been relatively a slight general increase in these diseases of the respiratory organs. They are, of course, largely dependent upon weather.

12. There has been a slight decrease in the inflammatory affections of the alimentary tract. In 3 of the mammals and 50 of the birds it was hæmorrhagic, and in 1 of the reptiles it was caused by worms. The remainder of the cases were apparently due to the quantity or quality of the food not being suitable to the animal.

13. There has been relatively a considerable decrease in the number of cases of nephritis in the mammals and birds. 24 of the cases in mammals and 7 of those in birds were acute. The remainder were chronic cases, of varying degrees, a number of which were associated with other old-age changes. About 100 of the deaths have been due to old age, or to the artificial old age induced by captivity.

14. In a Kiang which died after delivery; the wall of the uterus measured only one-sixteenth of an inch in thickness.

15. One of these cases was in a Wolf whose son died of the same disease, in the same position, in July 1914.

16. Two of these cases were in Deer, one in the nose and the other in the liver and intestine; the third was a lymphosarcoma of the mediastinal glands in a Hamster.

17. Under the term malaria are grouped 1 case due to *Plasmodium kochi*, 7 cases due to *Hæmoproteus danilewskyi*, and 1 due to *Plasmodium præcox*: see also section on blood-parasites below.

18, 19, 21. See sections on blood-parasites below.

20. The blood of 3 Viperine Snakes contained a number of large amœbæ, probably from the intestine; they were also found in numbers in the liver of a Mocassin Snake (comparable with the flagellated organisms found in the blood of reptiles and described in my Reports of 1912 and 1913, and in a paper on Blood-parasites found in the Gardens during the years 1908–1911: *vide* P. Z. S. 1912, pp. 235, 406; 1913, p. 141; and 1914, p. 181).

22. Of the aorta in a Seal and a Coati.

23. The large number of cases of fatty degeneration and infiltration of the liver is probably due to too rich food and insufficient exercise. The greater number of the birds are the small, highly coloured birds from the Small Bird-house, whose food-capacity is enormous.

24. By far the greater number of cases of gastric ulceration occur in the Primates, generally in connection with diseases of the kidneys or lungs.

25. In an Ibex with very considerable fæcal accumulation and symptoms of autointoxication.

26. Both kidneys of a Wallaby were filled with small stones: none in the bladder.

27. This was a small sarcomatous growth in the kidney of a Coypu Rat, probably arising from an adrenal inclusion.

BLOOD-PARASITES.

During the year the blood of every animal that died has been examined, with the result that parasites have been found in 46 cases, in 24 species for the first time.

They have been distributed as follows:—

Filariæ. In 2 mammals; in 1 species for the first time.
In 6 birds; in 4 species for the first time.
In 1 reptile for the first time.
Trypanosomes. In 2 reptiles.
Malaria. *Plasmodium kochi.* In 1 mammal for the first time.
Hæmoproteus danilewskyi. In 7 birds; in 3 species for the first time.
Plasmodium præcox. In 1 bird for the first time.
Leucocytozoa. In 3 birds; in all for the first time.
Toxoplasma. In 1 reptile for the first time.
Hæmogregarines. In 17 reptiles; in 7 species for the first time.
Intestinal organisms. In 5 reptiles; in 2 species for the first time.

The following list gives particulars of the blood-parasites in detail:—

Embryo Filariæ found in the blood of Mammals.

	HABITAT.	TYPE.
Lion Marmoset (*Leontocebus rosalia*) ...	Brazil.	Very long.
Found in the following for the first time:		
Woolly Monkey (*Lagothrix infumata*)...	S. America.	Long.

Embryo Filariæ found in the blood of Birds.

Chilian Starling (*Curæus aterrimus*) ...	Chili.	
Found in the following for the first time:		
White-eyebrowed Wood-Swallow (*Artamus superciliosus*).	N.S. Wales.	Long, thick.
3 Red Birds of Paradise (*Paradisea rubra*).	Waigiou Island.	Short, stout; 2 of the birds contained also filariæ of long thin type.
Military Starling (*Trupialis militaris*) .	Chili.	Long, thin.

Embryo Filariæ found in the blood of a Reptile: for the first time.

Wolf-Snake (*Coluber lætus*)	N. America.	Long, thin.

Trypanosomes found in the blood of Reptiles.

2 Edible Frogs (*Rana esculenta*)	Europe.	*T. rotatorium* type.

Plasmodium kochi *found in the blood of the following Mammal for the first time.*

	Habitat.
Mangabey (*Cercocebus æthiopicus*)	S. Nigeria.

Hæmoproteus danilewskyi *found in the blood of Birds.*

Indian Dial Bird (*Copsychus saularis*)	India.
Black-throated Lorikeet (*Trichoglossus nigrogenis*)	Tasmania.
2 Brown-necked Parrots (*Pœocephalus fuscicollis*)	Gambia.

Found in the following for the first time:

Yellow-fronted Barbet (*Cyanops flavifrons*)	Ceylon.
Larger Hill-Mynah (*Gracula intermedia*)	N. India.
Red Bird of Paradise (*Paradisea rubra*)	Waigiou Island.

Plasmodium præcox *found in the blood of the following Bird for the first time.*

American Robin (*Turdus migratorius*)	N. America.

Leucocytozoa found in the blood of the following Birds for the first time.

White-eyebrowed Wood-Swallow (*Artamus superciliosus*)	N.S. Wales.
Nonpareil Finch (*Cyanospiza ciris*)	N. America.
Alario Finch (*Alario alario*)	S. Africa.

Toxoplasma found in the blood of the following Reptile for the first time.

Say's Snake (*Coluber melanoleucus*)	Mexico.

Hæmogregarines found in the blood of Reptiles.

Indian Python (*Python molurus*)	India.
2 Indian Cobras (*Naia tripudians*)	India.
Hog-nosed Snake (*Heterodon platyrhinos*)	N. America.
Blood-stained Terrapin (*Cinosternum cruentatum*)	N. America.
Æsculapian Snake (*Coluber longissimus*)	Europe.
Common Boa (*Boa constrictor*)	S. America.
Banded-tailed Tree-Snake (*Leptophis liocercus*)	S. America.
Anaconda (*Eunectes marinus*)	S. America.
Cooke's Tree-Boa (*Corallus cookii*)	Trinidad.

Found in the following for the first time:

	Habitat.	Type.
Wolf Snake (*Coluber lætus*)	N. America.	Cells enlarged and dehæmoglobinised.
Pennsylvanian Mud-Terrapin (*Cinosternum pennsylvanicum*).	N. America.	Stout.
Black-collared Cobra (*Naia nigricollis*).	W. Africa.	Long.
2 West African Sand-Snakes (*Psammophis elegans*).	W. Africa.	Cells enlarged and dehæmoglobinised.
West African Trionyx (*Trionyx triunguis*)	W. Africa.	Stout.
Rufescent Snake (*Leptodira hotambœia*).	W. Africa.	Very small, like *Lankestrella*.
Shielded Eryx (*Eryx thebaicus*)	Gold Coast.	Long, irregular: cells dehæmoglobinised.

Intestinal Organisms found in the blood of Reptiles.

	HABITAT.	TYPE.
Carolina Box-Tortoise (*Cistudo carolina*).	N. America.	Hexamitus.
Found in the following for the first time:		
3 Viperine Snakes (*Tropidonotus viperinus*).	Europe.	Amœbæ.
Mocassin Snake (*Tropidonotus fasciatus*)	N. America.	Amœbæ.

Addendum to Report on the Deaths for 1914, published in Proc. Zool. Soc., March 1915.

Owing to the wrong figures having been sent to me from the Office, the figures in paragraphs 1 and 2 of the 1914 Report, p. 123, and in paragraphs 1 and 2 of the Notes, p. 126, are incorrect: these paragraphs should read as follows:—

Paragraphs 1 and 2, p. 123.

On January 1st, 1914, there were 788 mammals, 2436 birds, and 575 reptiles in the Zoological Gardens; and during the year 373 mammals, 1174 birds, and 470 reptiles were admitted, making a total for the year of 1261 mammals, 3610 birds, and 1045 reptiles.

During 1914, 309 mammals, 867 birds, and 301 reptiles have died: that is, a percentage of 24·6 for mammals, 24 for birds, and 28·8 for reptiles. . . . . . . Of these 719 animals, 141 were mammals, 375 were birds, and 203 were reptiles; and if these be deducted from their respective totals, the death-rate percentage will come out as 13·3 for mammals, 13·6 for birds, and 9·3 for reptiles.

Paragraphs 1 and 2 of *Notes on the foregoing Tables*, p. 126, will read as follows:—

1. The total incidence of infectious diseases in the Gardens is about 7·5 per cent. for mammals, 9 per cent. for birds, and 8·1 per cent. for reptiles.

2. The following are the percentages of deaths from tubercle during the year: mammals ·9 per cent., birds 3·1 per cent., and reptiles ·38 per cent. on the total numbers for the year, etc., etc.